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Drawing Standards & Conventions

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1918.

Drawing Standards and Conventions

UNIVERSITY OF MICHIGAN
DEPARTMENT OF ENGINEERING
MECHANICAL DEPARTMENT

GEORGE WAHR, PUBLISHER
Ann Arbor, Mich.

Standards and Conventions

UNIVERSITY OF MICHIGAN
DEPARTMENT OF ENGINEERING
MECHANICAL DEPARTMENT

1906

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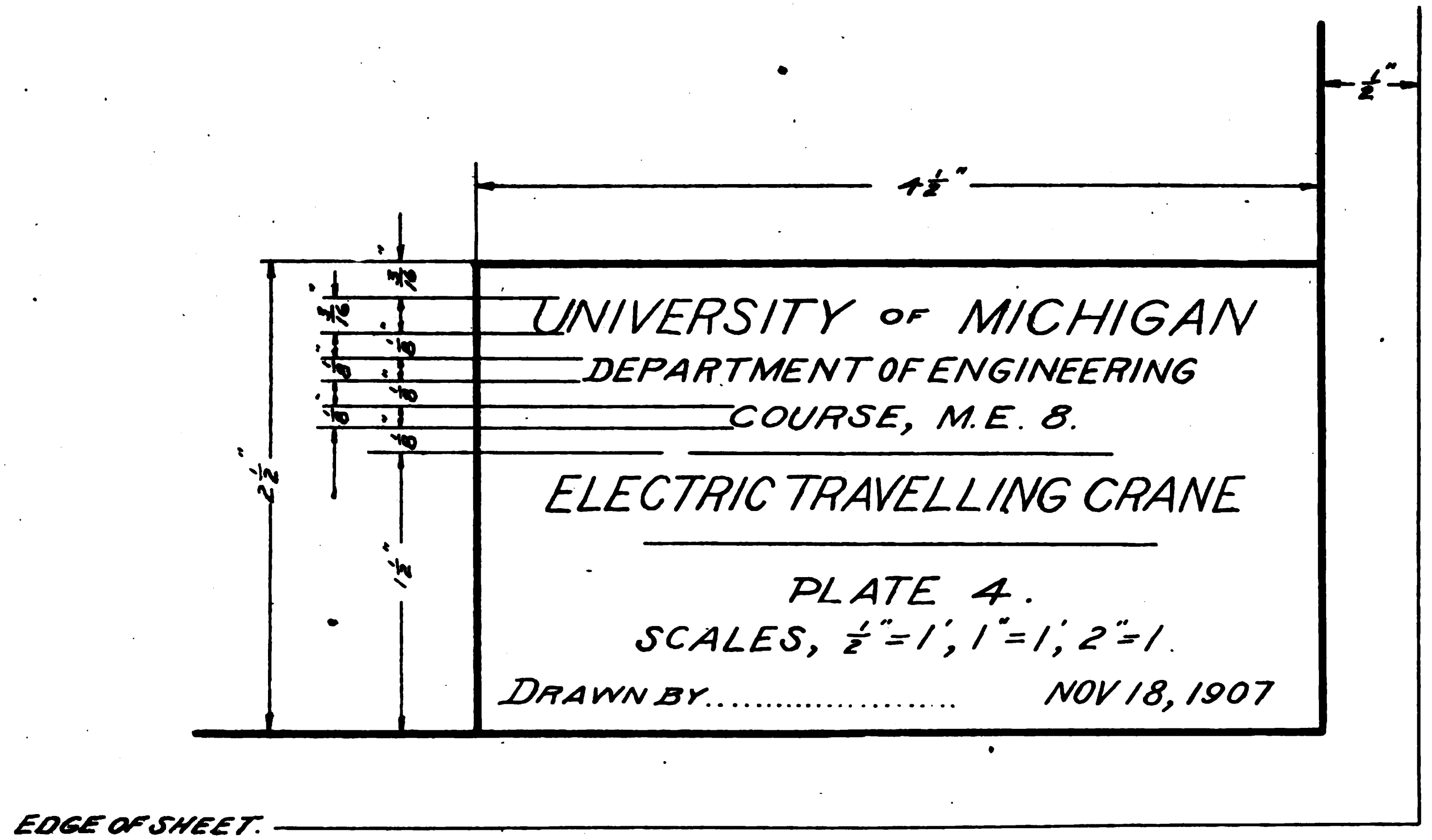
PREFACE

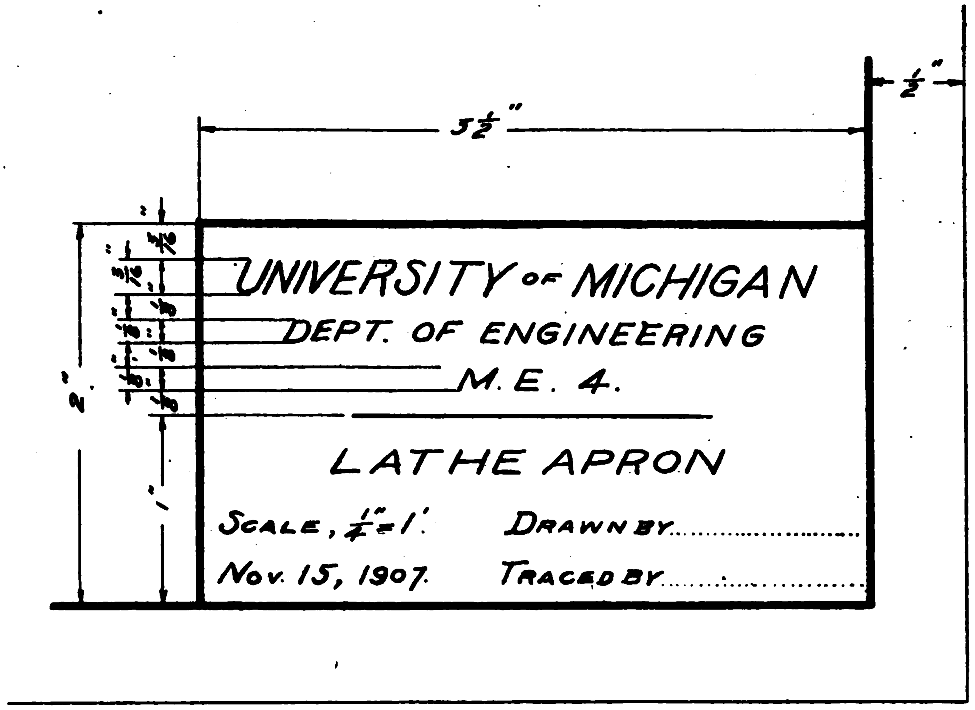
Every engineering office or concern finds it necessary to adopt some system of standardization of drawings, in order to secure uniformity and to facilitate work. These systems vary in many details in different concerns, but it is manifestly desirable that, in so far as practicable, a general uniformity of methods be secured.

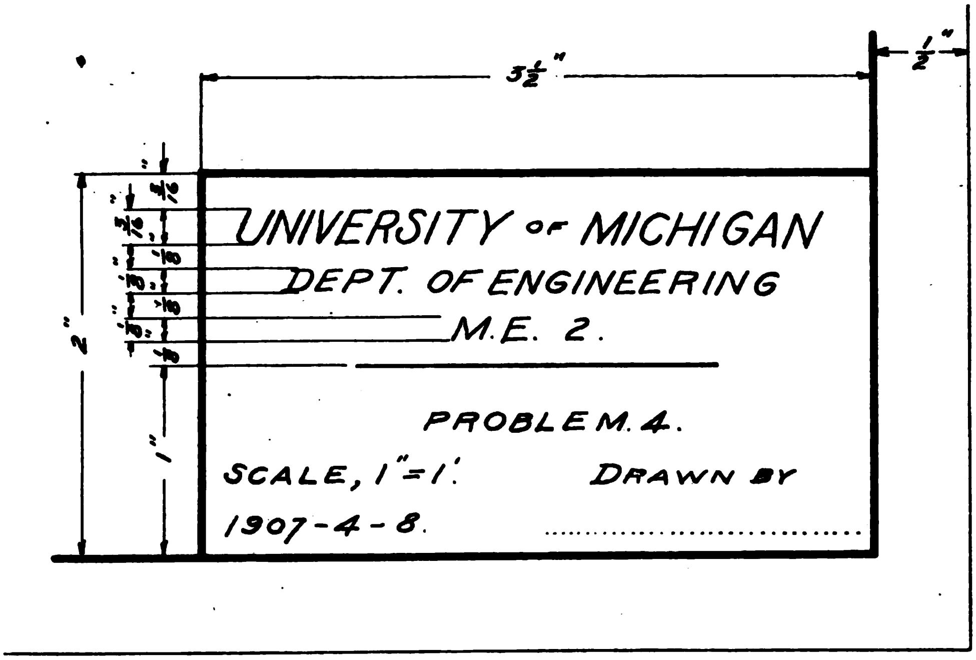
Accordingly, the Mechanical Department, after carefully collecting and comparing information obtained from a large number of the best concerns in the country, has adopted the following standards and conventions to be used in all courses in drawing and design.

DEPARTMENT OF
ENGINEERING DRAWING


4½"
½"
3/16
1/8
2½"
1½"
UNIVERSITY OF MICHIGAN
DEPARTMENT OF ENGINEERING
COURSE, M.E. 8.
ELECTRIC TRAVELLING CRANE
PLATE 4.
SCALES, ½"=1', 1"=1', 2"=1.
DRAWN BY......................
NOV 18, 1907
EDGE OF SHEET.

TITLE BLOCK.
LARGE SIZE





TITLE BLOCKS.

SMALL SIZE.

PLATE 2.

Drawing Standards and Conventions

OF SHEETS

STANDARD SHEETS shall be as follows:

24" x 36"
18" x 24"
12" x 18"
9" x 12"
6" x 9"

DERS

All sheets to have ½" border on all sides, giving working spaces inside of border lines as follows:

23" x 35"
17" x 23"
11" x 17"
8" x 11"
5" x 8"

der Lines

Border line to be one solid line 1/32" in width.

TLE BLOCK
Plates 1 and 2

Title block to appear in lower right hand corner of the working space, its right and lower sides being formed by the border lines, the left and upper sides to be of the same weight as the border line.

TITLE BLOCK to be rectangular—

2" x 3½", or
2½" x 4½"

depending on the sizes of sheets and the title necessary.

Each title block to contain the following:
1st line—University of Michigan.
2nd line - Department of Engineering.
3rd line—Name or symbol of course.
Below—The date and the draughtsman's signature.

Generally the title block should also contain the subject of the drawing and the scale of the drawing.

CAPS AND SMALL CAPS.

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1/8"
ABCDEFGHIJKLMNOPQRSTUVWXYZABC 3/32"
ABCDEFGHIJKLMNOPQRSTUVWXYZ 3/32"
ABCDEFGHIJKLMNOPQRSTUVWXYZABC 1/16"

DETAILS OF WET GRINDER.

MAKE THREE. TAP 4 HOLES, 1/4" DIA. 7/8" DEEP.

1/2" DRILL. STANDARD BOLTS.

SCALE FULL SIZE.

NOTE :- FILLET RADII ON ALL GEARS TO BE 1/4".

3/4" TAP. TAPER 1 3/4" PER FOOT.

TRACED BY C.N.G.

1234567890 3/32"
1234567890 1/8"

Caps and Lower Case Letters.

abcdefghijklmnopqrstuvwxyz.
abcdefghijklmnopqrstuvwxyz. [illegible]

Notes, remarks, instructions, etc., may be plain 1/8"
lower case or cap letters. Such notation,
however, must be uniform on the same sheet.

1/2" Drill. Scale, 1" = 1'. 3/4" Tap.

1234567890 1/8"

PLATE 3.

RING

3

All lettering must be neat and legible, any notation upon the sheets to read from the bottom or right hand.

All titles and names of parts are to be in caps. All letters in the title block to be freehand.

Notes, remarks, instructions, etc., may be plain lower case or cap letters. Such notation, however, must be uniform on the same sheet. In view of information obtained from leading manufacturing concerns, the use of plain inclined capitals is strongly recommended. In lettering drawing sheets, use no more than two sizes of letters to distinguish between titles or names of detail parts and subordinate notes, remarks, scales, etc.

ps and Small Caps

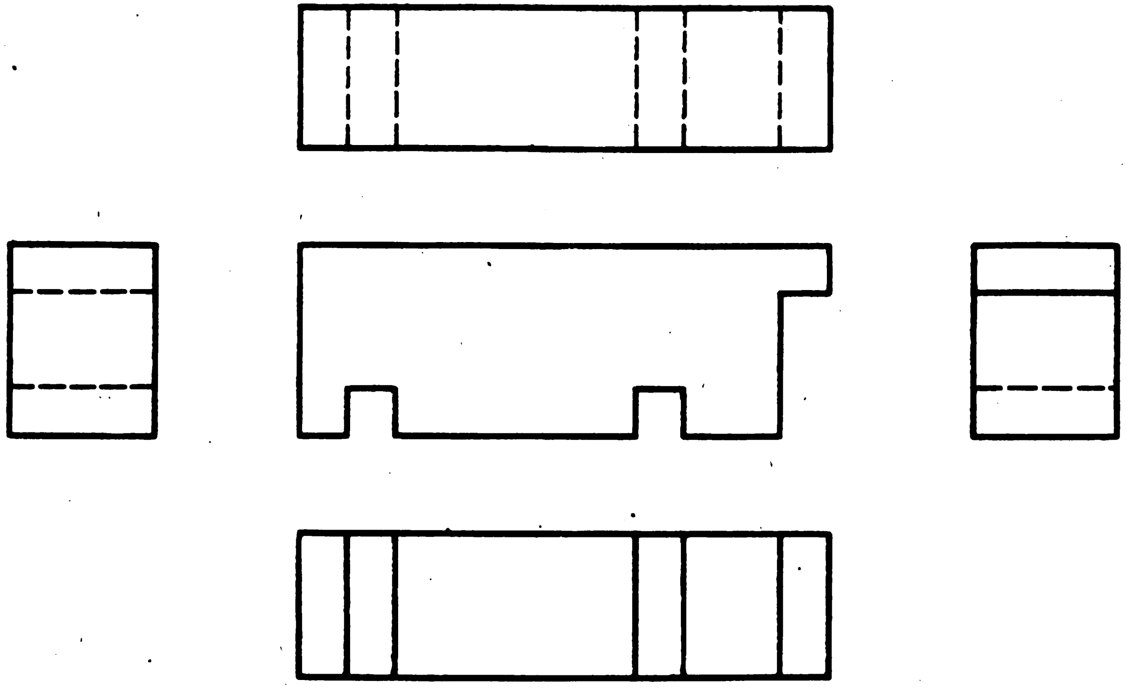
In using caps and small caps, the large caps are to be ⅛" high, the corresponding small caps being 3/32" high; or 3/32" high, the corresponding small caps being 1/16" high. The larger sizes are generally preferable, the smaller to be used only when absolutely necessary.

ps and Lower Case

In using caps and lower case, the caps should be ⅛" high and the lower case letters ⅗ of the height of the caps.

bers

Use plain vertical or inclined figures, the latter preferred. Height of figures should be the same as that of capital letters.



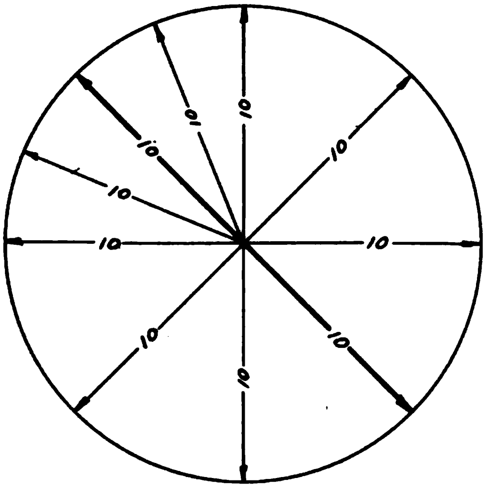
THIRD ANGLE PROJECTION.

ANGLE PROJECTION

Plate 4

Use third angle projection, that is, show views of an object as indicated on *plate 4*.

When absolutely necessary to put one view out of its proper relative position, it should be indicated by a clear note, and an arrow showing direction of view.



DIMENSION DIAGRAM.

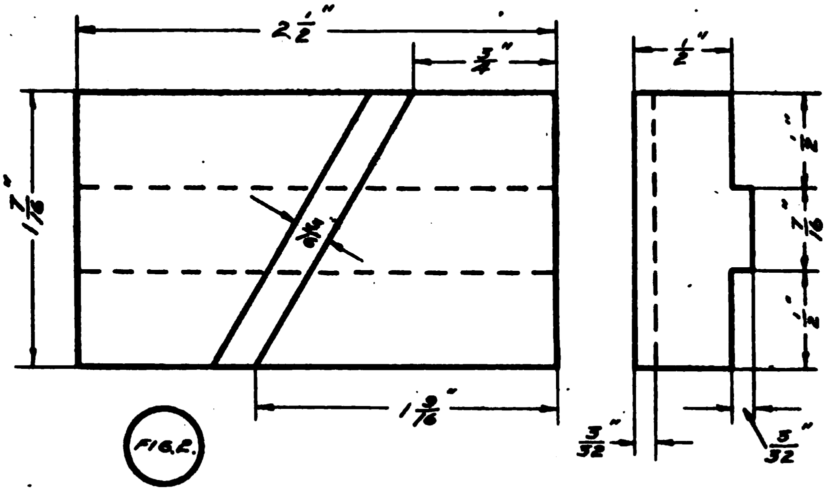


FIG.2.

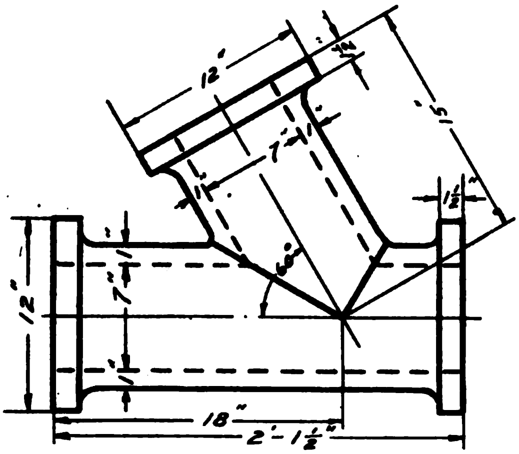


FIG.3.

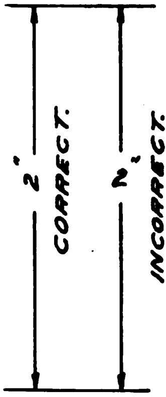


FIG.4

PLATE

ENSIONS

Plates 5 and 6

ines

Use for dimension lines full hair lines, breaking same for the dimension. These dimension lines are to terminate in neat arrow points, which reach exactly to the point to which, or from which the dimension is taken.

rrows

Use long slender arrows, as per illustrations. (Arrow points not to be filled in except as results in making the two usual strokes). Middle of dimension figure to be at the level of the dimension line. Lead or dimension reference lines to extend slightly beyond the arrows on dimension line proper.

To Read

All dimensions to read from the bottom or the right hand side of the sheet. (See dimension diagram.) All dimensions to be written so as to read in the direction of the dimension line. *See plate 5, fig. 4.*

Small Parts

Where the part dimensioned is very small or when dimensions would be crowded, place arrows and dimensions outside. *See plate 5, figs. 2 and 3.*

Break Cross-sectioning

If dimension appears inside of a cross $\left\{\begin{matrix}\text{sectioned}\\ \text{hatched}\end{matrix}\right\}$ piece, break the cross-sectioning around the dimension. *Plate 6, fig. 1.*

Numbers

Use plain vertical or inclined figures, the latter preferred. *See plate 3.*

Height

Make dimensions about ⅛″ in height, taking great care to have all dimensions on the same sheet uniform in size and weight.

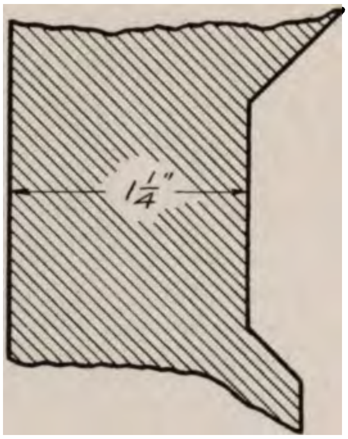
ractions

Figures which constitute a fraction to be somewhat smaller than those in the whole numbers, the entire height of a fraction to be about 1½ times that of the whole number. Write all fractions with the division line horizontal.

Conventional Fractions

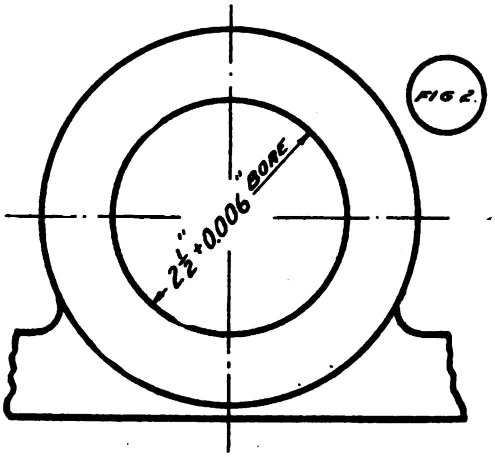
Fractions to be used in dimensioning are such as have the denominators shown in the following: $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{8}$ $\frac{1}{16}$ $\frac{1}{32}$ $\frac{1}{64}$. Do not use such fractions as $\frac{3}{10}$ $\frac{1}{5}$.

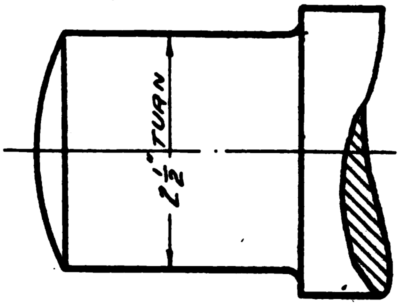
FIG. 1.



BROKEN CROSS SECTIONING.

FIG. 2.





ALLOWANCES FOR SPECIAL FITS.

FIG. 3.

FIG. 4.

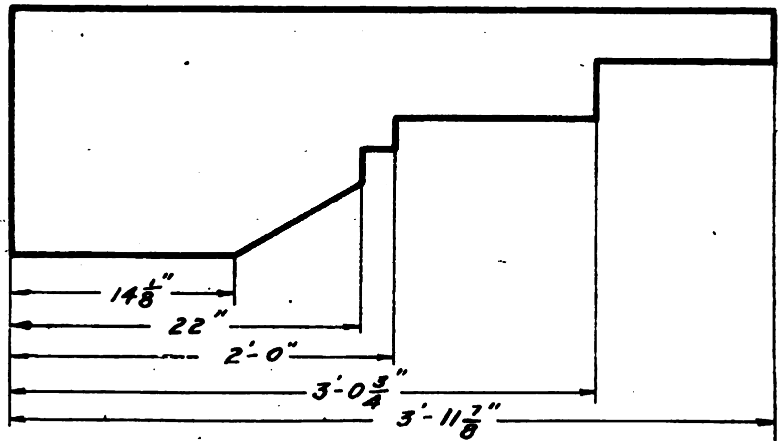


PLATE 6

als

If accurate dimensions must be given which cannot be expressed in the above conventional fractions, give the same in decimals. Other dimensions to remain as usual in fractions.

ll Dimensions

If small dimensions are given in thousandths of an inch (as for clearance, etc.) do not omit the zero before the decimal point. Write 0.006″.

In indicating small amounts to be allowed for special fits, express dimensions as follows:

3″ + 0.005″
2¼″ — 0.006″

See plate 6, figs. 2 and 3.

ress in inches up to 2 feet

Dimensions up to but not including 2 feet are to be given in inches and fractions thereof only. Dimensions 2 feet and above to be given in feet, inches and fractions of an inch. Do not use fractions of feet. *See plate 6, fig. 4.*

Always separate the number expressing feet from that expressing inches by a horizontal line, thus:

3′ — 4″ and 8′ — 3⅞″

When expressing a whole number of feet and no inches, or a whole number of feet and a fractional part of an inch, express as follows:

2′ — 0″
4′ — 0¾″

bols of Feet and nches

Indicate feet and inches as in the following example:

7′ — 8⅛″ [*not* 7 ft. 8⅛ in.]

Except in indicating elevations of floor, water levels, etc., which are generally given as follows:

EL.: 109.25 ft.

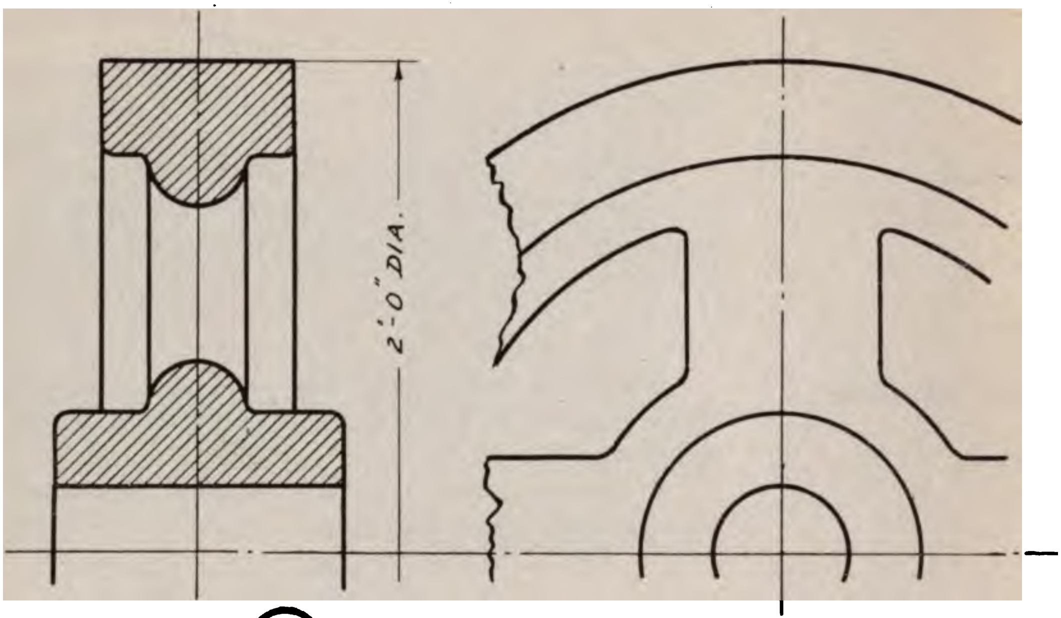


FIG. 1. DIAMETRAL DIMENSION.

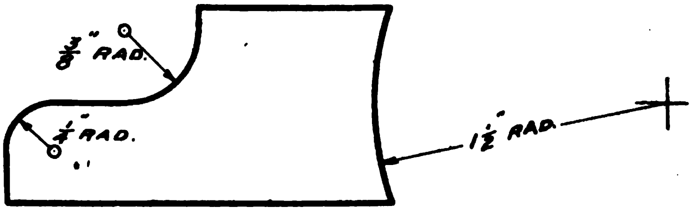


FIG. 2. RADIAL DIMENSIONS.

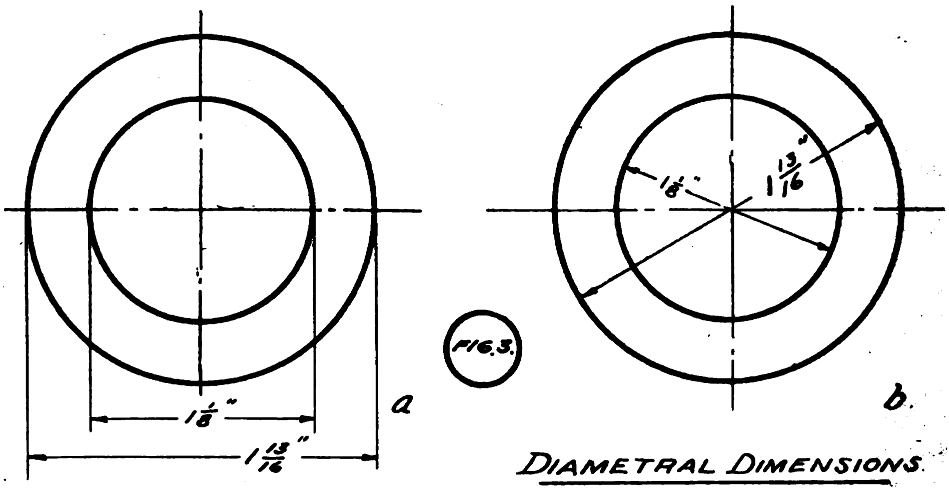


FIG. 3. DIAMETRAL DIMENSIONS.

PLATE

TERS
te 7

In denoting diameters, wherever the dimension is not obviously that of a diameter use DIA. in connection with the dimension as, 2¼" DIA. *Plate 7, fig. 1.*

al Dimensions

Where it is absolutely necessary to give a radial dimension write the same 5¼" RAD. *Plate 7, fig. 2.*

etral Dimensions
Preferred

Diametral dimensions are always preferable and should always be used for complete circular outlines. Use radial dimensions only where the circular outlines are not complete, as in case of fillets, rounded corners, etc.

ethod

In showing ordinary diametral dimensions, use either form (a) or (b) as on *plate 7, fig. 3.* When dimensioning very small diameters, (b) is to be preferred.

VERALL DIMENSIONS

Overall dimensions on all detail parts and on every complete machine are desirable. On very simple pieces, such as the one shown on *plate 8, fig. 1,* where the overall dimension is not of importance, the overall dimension may be omitted as shown.

Repeating

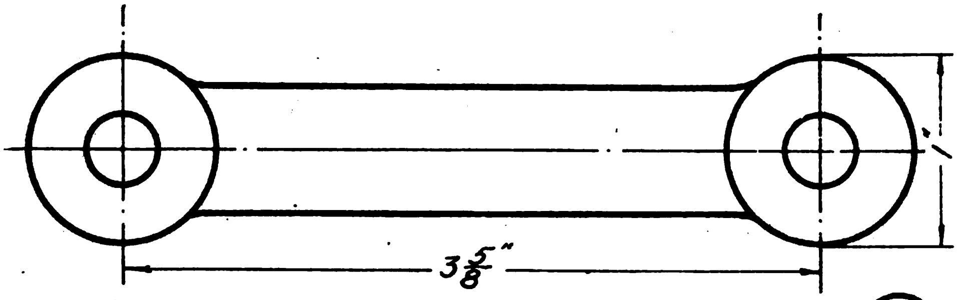
Dimensions other than the principal dimensions should not be unnecessarily repeated in the several views.

Assembled Drawings

On assembled drawings, only those dimensions which are vital to the design are to be shown, such as general overall dimensions, location of principal centers, etc.

General

In every case of dimensioning, however, keep always in mind the *purpose of the drawing* when deciding what dimensions to give and what to omit.



CENTER LINES.

FIG. 1.

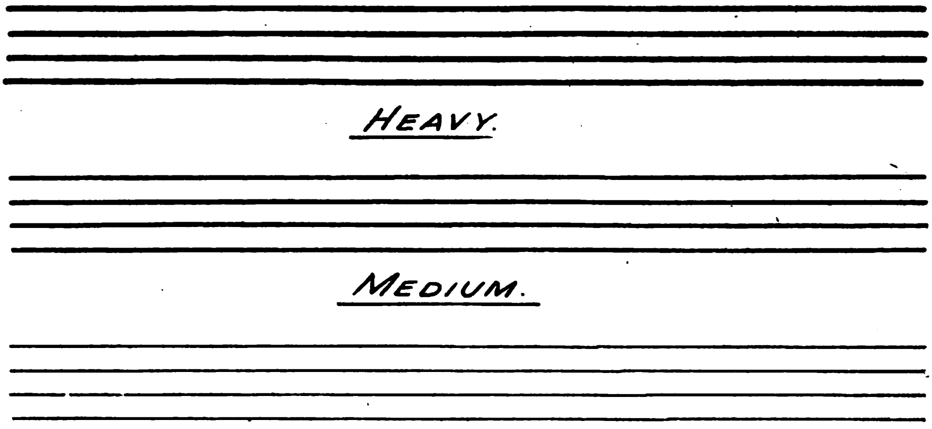


FIG 2.

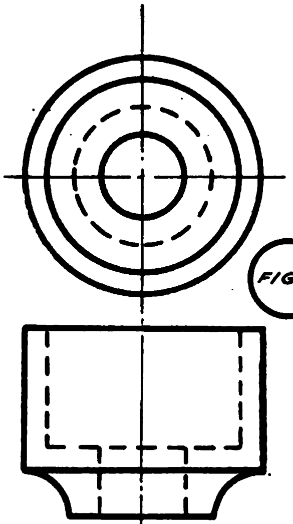


FIG. 3.

INVISIBLE OUTLINES.

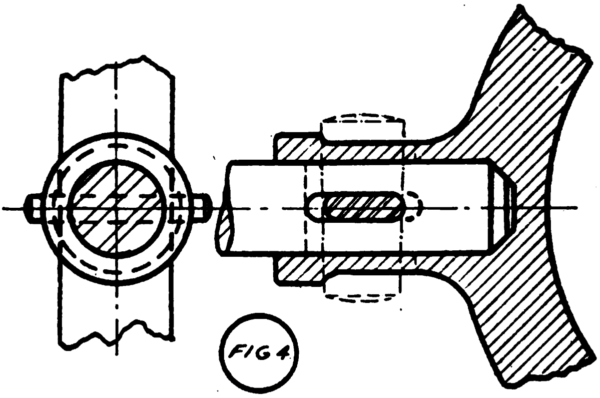


FIG 4.

PART SHOWN OUT OF PROPER RELATIVE POSITION

PLATE

CENTER LINES

Plate 8, fig. 1

All center lines to be long hair dash and single dot lines. Do not end center lines on any line of the piece, but carry them beyond. Never use center lines for dimension lines.

OUTLINES

Weight

The weight of outlines should be graded according to the size of the parts. *See plate 8, fig. 2* for samples.

In general, outlines should be about as per line marked "heavy."

Invisible Lines

Invisible lines on the piece are to be made short dash lines, of slightly lighter weight than the outlines. No more invisible lines should be shown than are necessary for clearness. *See plate 8, fig. 3.*

Adjoining Parts, and Parts Out of Place

Adjoining parts or objects not properly part of the drawing and added merely for clearness, also parts shown out of their proper relative position, should be delineated in short dash-dot lines, in weight the same as or lighter than the invisible lines. *See plate 8, fig. 4.*

No Shade Lines

Shade lines, such as are shown on *plate 9, fig. 1*, are *not* to be used, except in special cases.

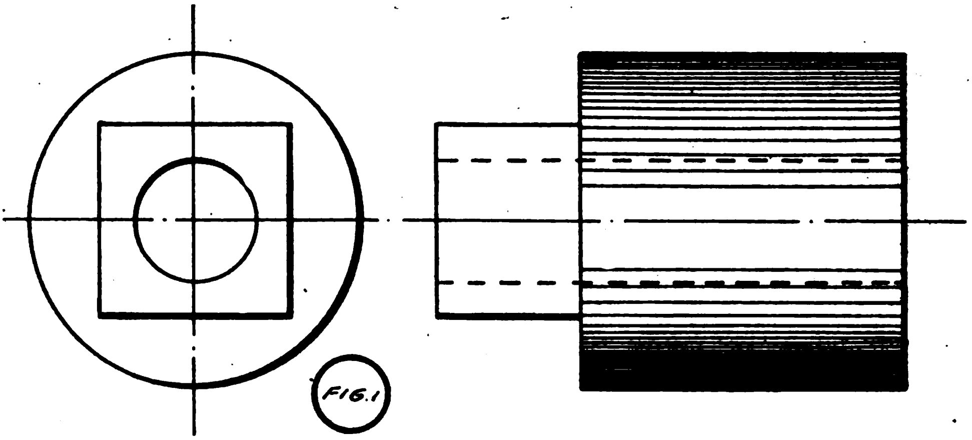
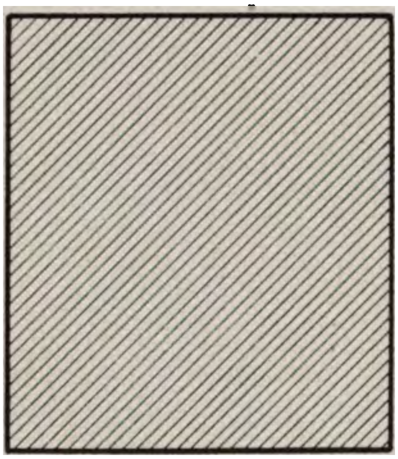
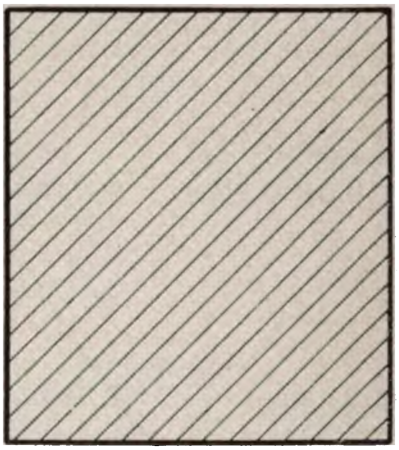


FIG. 1

SHADE LINES. NOT TO BE USED.





CROSS SECTIONING

ORDINARY SPACING

FIG 2

FOR LARGE SECTIONS.

FIG 3

PLATE

CROSS {SECTIONING / HATCHING}

Plate 9

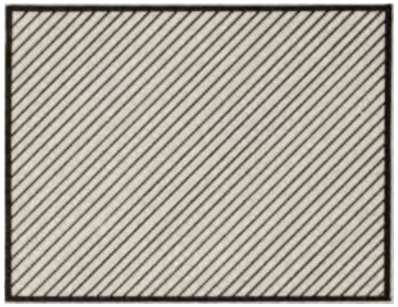
All cross-section lines to be drawn at an angle of 45° with the sheet when possible In any sectional view, the cross-sectioning on each individual piece is to be uniform. When two different pieces adjoin, distinguish them by cross-section lines drawn with opposite slope. The use of some form of section liner is recommended.

Section Lines

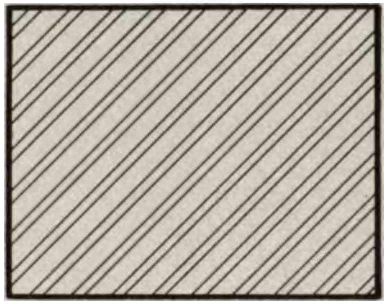
Ordinary cross-section lines to be light, full lines (somewhat heavier than center lines). *See plate 9, fig. 2.*

Adjust spacing of cross-section lines to the size of the piece. Two samples of cross-section lining are shown on *plate 9, figs. 2 and 3.*

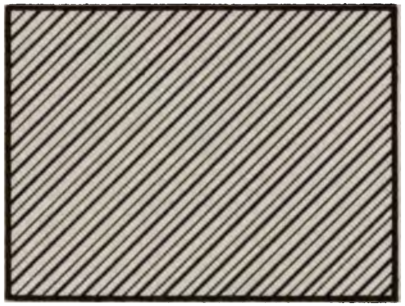
CONVENTIONAL CROSS-SECTIONING.



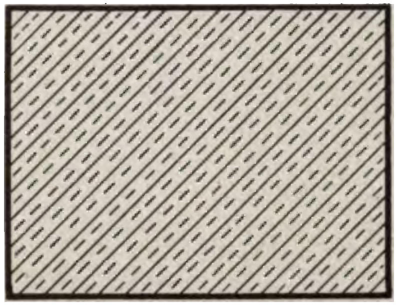
CAST IRON.



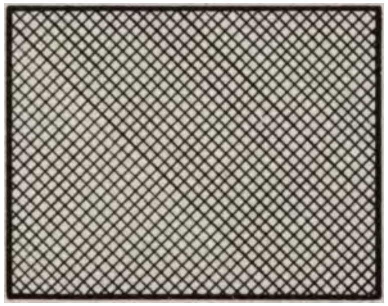
CAST STEEL.



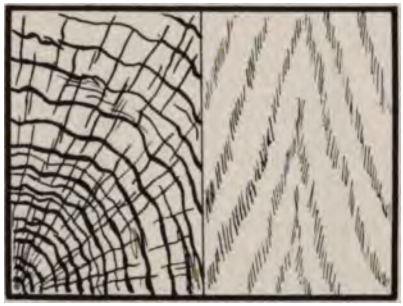
STEEL & WRO'T IRON.



BRASS & BRONZE.



BABBITT, LEAD, ETC.



WOOD.

REPRESENTATION OF METALS, ETC.

Plate 10

1. Cast Iron is shown by lines of equal weight and spacing.

2. Cast Steel, lines of equal weight and alternate narrow and wide spacing. (Omit every third line in 1).

3. Wrought Steel and Wrought Iron to be shown by alternate heavy and light lines.

4. Brass, Bronze and Copper to be light, solid and broken lines alternating. (Same as 1 with every alternate line broken.)

5. Babbitt, Lead and other soft materials to be light double cross-sectioned. (1 and its opposite.)

6. Wood is indicated by representing end or side grain.

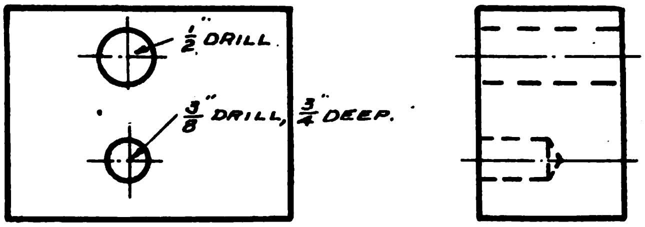


FIG. 1.

DRILLED HOLES.

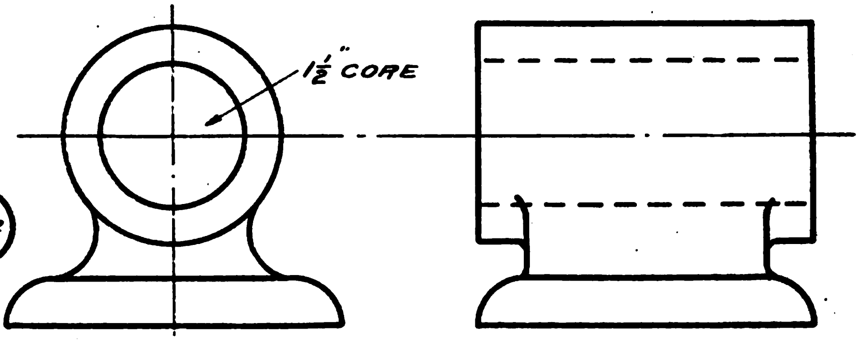


FIG 2.

CORED HOLE.

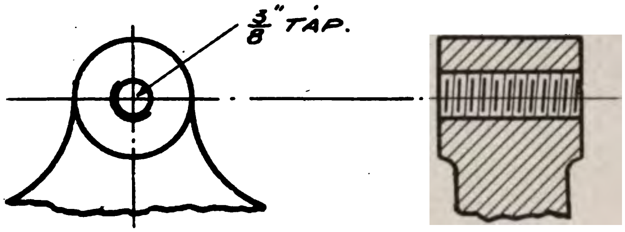


FIG. 3.

TAPPED HOLE.

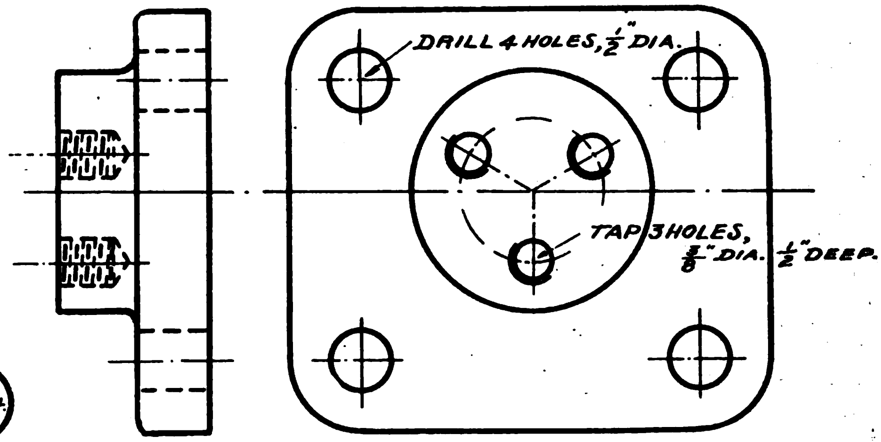


FIG. 4.

GROUPED HOLES.

PLATE II

SCALES

All scales are to be given in the title block.

If several different scales are used on the same sheet, these scales may be shown *also* at the several pieces.

Notation

In indicating any scale except full size express in the form—

Scale, $3'' = 1'$.

Table of Scales

The following scales to be used:

Full size.
$6'' = 1'$
$4'' = 1'$
$3'' = 1'$
$2'' = 1'$
$1\frac{1}{2}'' = 1'$
$1'' = 1'$
$\frac{3}{4}'' = 1'$
$\frac{1}{2}'' = 1'$
$\frac{3}{8}'' = 1'$
$\frac{1}{4}'' = 1'$
$\frac{1}{8}'' = 1'$
$\frac{1}{16}'' = 1'$

DRILLED HOLES

Plate II, fig. 1

Express note for drilled holes as indicated on *plate II, fig. I*, in the form: $\frac{5}{8}''$ Drill.

CORED HOLES

Plate II, fig. 2

Mark cored holes in same general way as drilled holes, as $1\frac{1}{2}''$ Core.

TAPPED HOLES

Plate II, fig. 3

Use arrow and note for indicating tapped holes, as below:

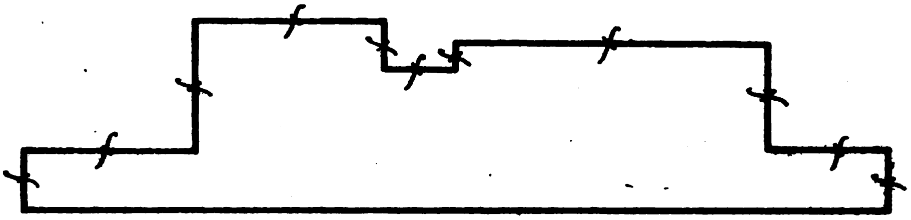
$\frac{3}{4}''$ tap
$\frac{3}{4}''$ tap $1\frac{1}{4}''$ deep.

GROUPED HOLES

Plate II, fig. 4

When a number of holes are grouped, a blanket note may be used as—

Drill 5 holes $\frac{5}{8}''$ diameter
Core 16 holes $1\frac{1}{2}''$ diameter
8 holes $\frac{3}{4}''$ tap $1\frac{1}{4}''$ deep.



FINISH MARKS

FIG. 1

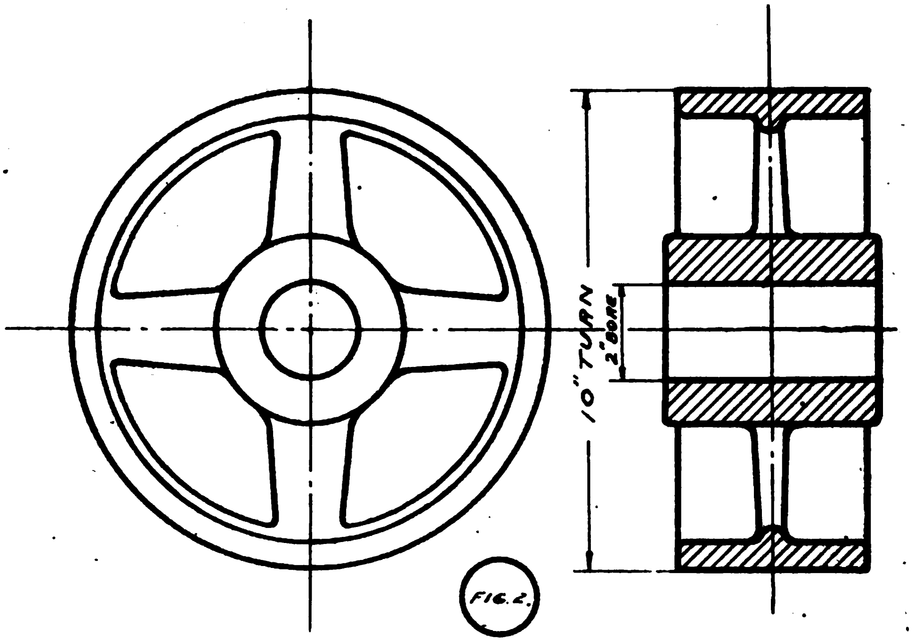


FIG. 2.

FINISH MARKS OMITTED.

FINISH OTHERWISE SHOWN.

PLATE

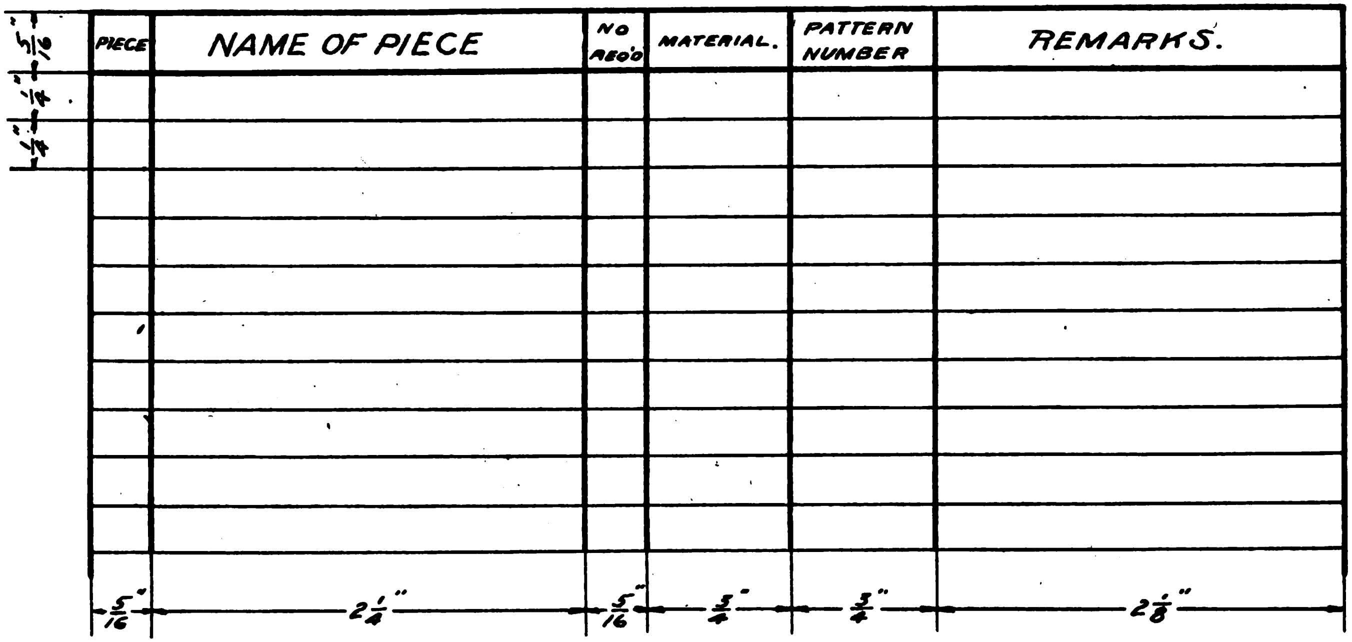
FINISHED SURFACES

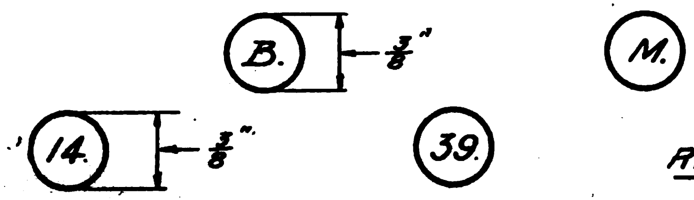
Plate 12

Mark surfaces which are to be finished with a small *f*, crossing the finish line and being itself crossed on the line, as indicated on *plate 12*, *fig. 1*.

When the finishing operation is otherwise denoted (that is, by a note such as: 1¼" Bore or 2⅛" Turn) the finish mark may be omitted. *Plate 12*, *fig. 2*.

LIST OF PARTS.





REFERENCE MARKS.

PLATE 13

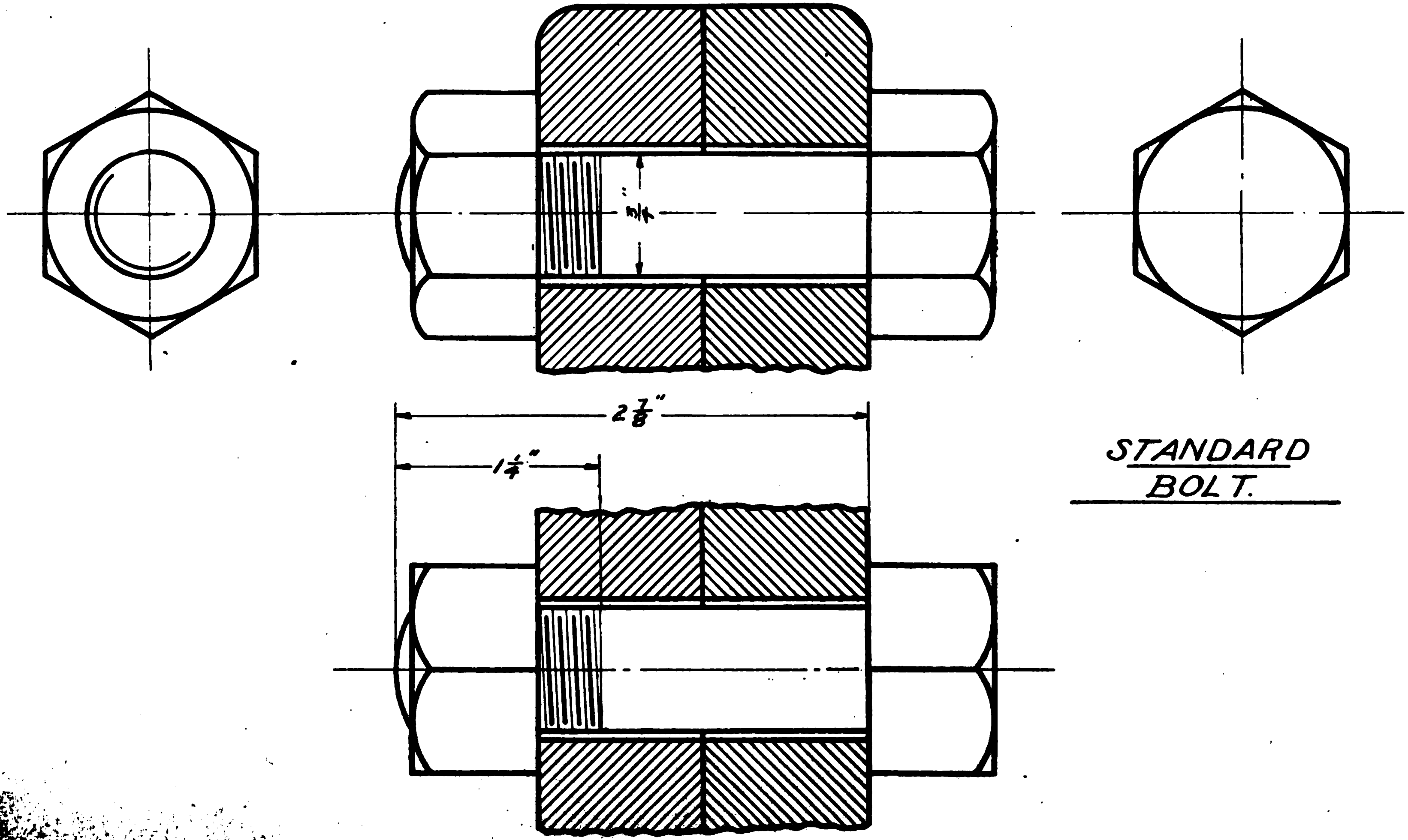
LIST OF PARTS OR BILL OF MATERIALS

Plate 13

When a list of parts or a bill of materials is required, give the same in a table as shown on *plate 13*.

Mark

Each piece shall be designated by a reference mark in a heavy $\frac{3}{8}''$ circle at the piece. Either numbers or letters may be used for these reference marks. *See plate 13*.



STANDARD BOLT.

PLATE 14

CONVENTIONS

SCREW THREADS

Plate 14

Screw threads are to be shown as on *plate 14*, using alternate light and heavy lines, sloped at approximately the same angle with the center line as the thread.

Internal

For internal threads, reverse threads as shown on *plate 15*.

In Nut

Do not show invisible threads through a nut on a bolt or stud. *Plates 14 and 15.*

Do Not Section Nuts

Standard nuts on a bolt or stud should never be shown in section. *Plates 14 and 15.*

STANDARD BOLT

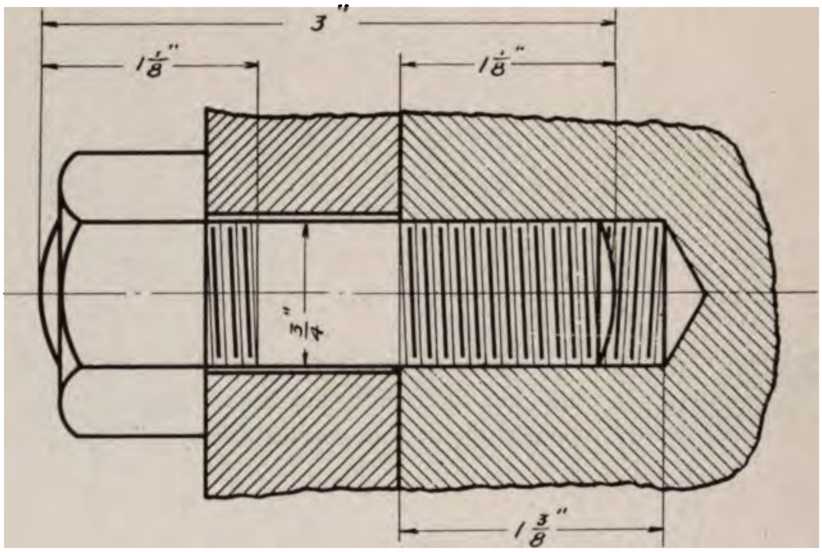
Plate 14

In dimensioning a Standard Bolt, give:

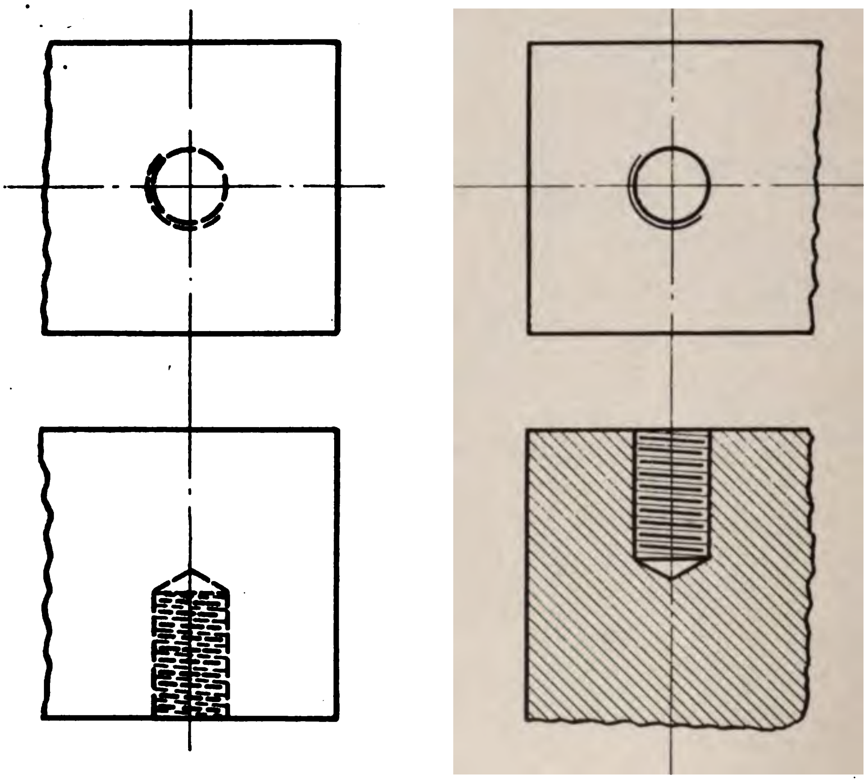
(a) Diameter of bolt.

(b) Length under head. When countersunk, give length overall.

(c) Threaded length.



STUD.



INVISIBLE.

VISIBLE.

TAPPED HOLES.

PLAT

TAPPED HOLE
Plate 15

A tapped hole in plan is indicated by a pair of concentric circles, the outer one stopped at the 45° lines. *See plate 15.*

In elevation (section), use conventional screw thread reversed. When the hole does not pass through the tapped piece, the bottom has a point of 120 degrees.

Invisible

When necessary to show invisible tapped holes in plan or elevation use the same method of delineation as above, with dashed lines throughout. *Plate 15.*

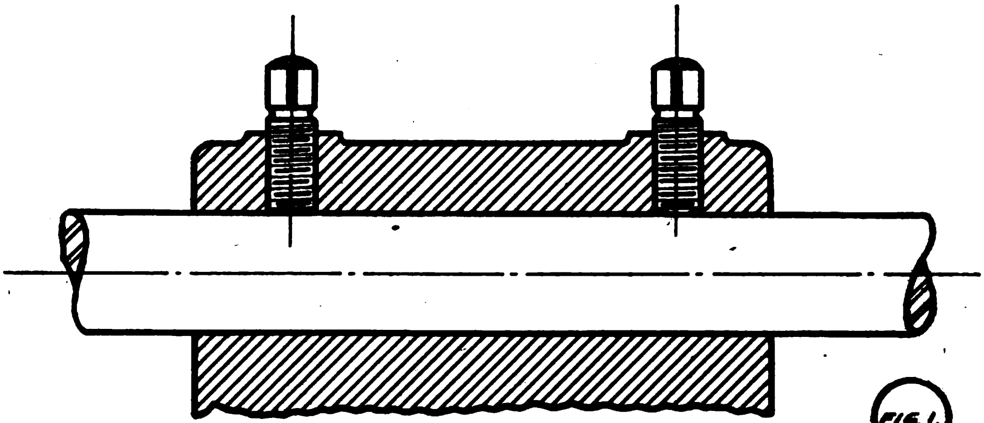


FIG. 1.

SHAFTS, RODS, ETC., FALLING IN PLANE OF SECTION.

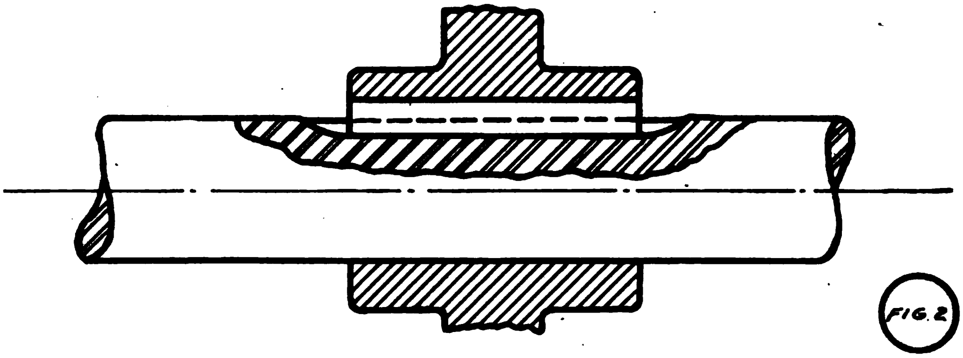


FIG. 2.

PARTIAL SECTION.

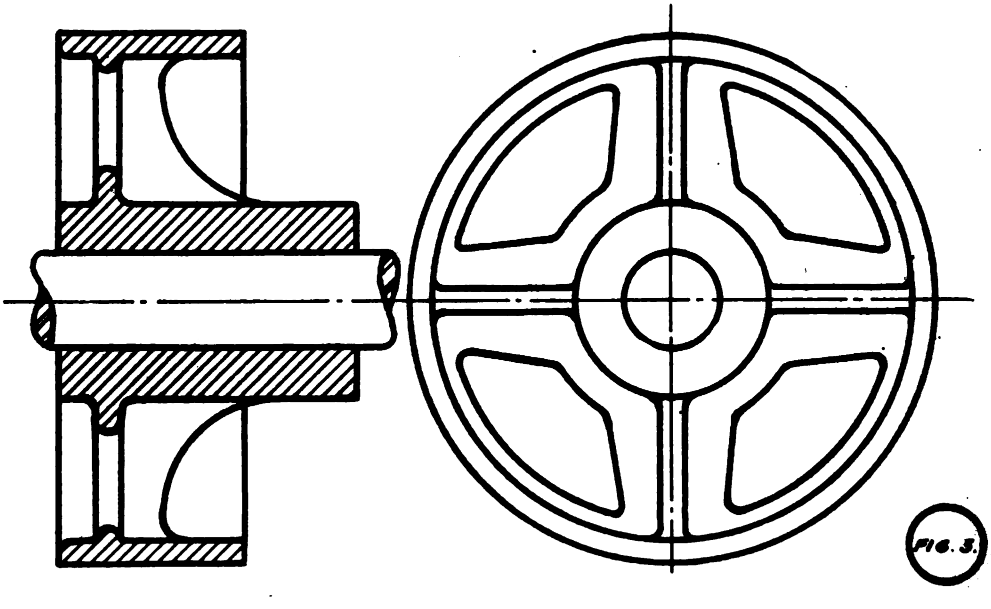


FIG. 3.

WEBS, RIBS, SPOKES, IN PLANE OF SECTION.

PLATE

SHAFTS, ETC. *Plate 16, fig. 1*	A shaft, solid rod, bolt or stud, whose axis falls in the plane of section should not be shown in section.
PARTIAL SECTIONS *Plate 16, fig. 2*	Partial sections are allowable, as for showing keyways, etc. Sections may be zigzagged. Show always where section is taken with arrows.
WEBS, RIBS, ETC. *Plate 16, fig. 3*	Webs, ribs, spokes, etc., falling in the plane of section should not be cross-sectioned.

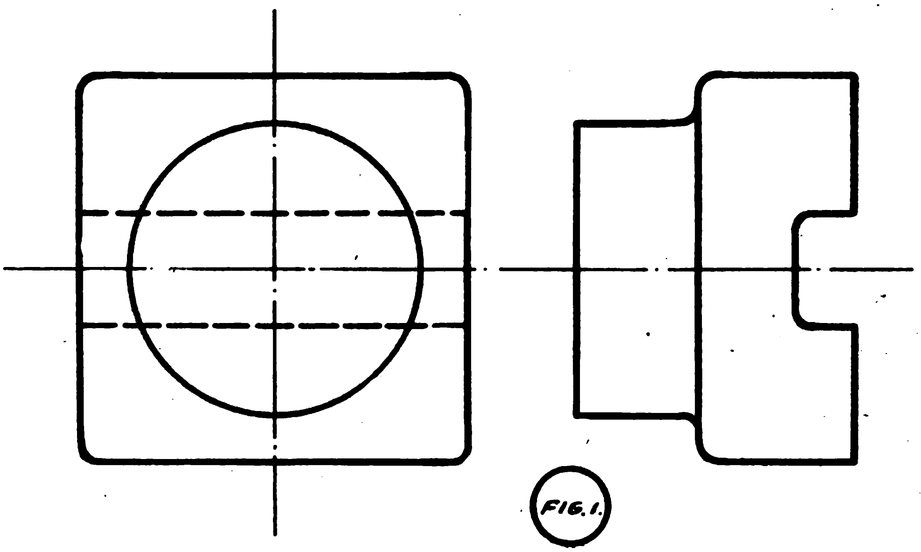


FIG. 1.

ROUNDED CORNERS & FILLETS.

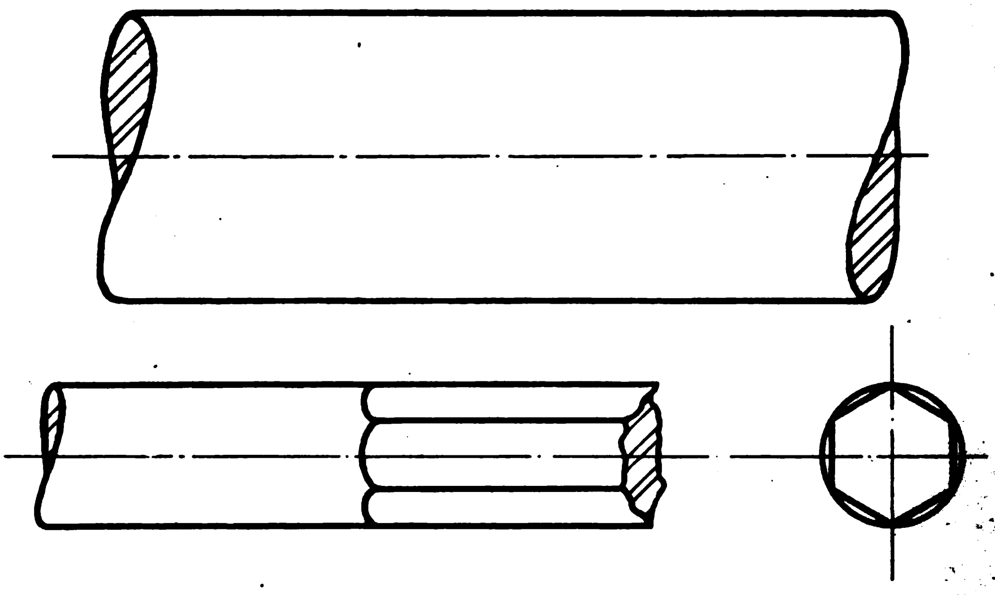


FIG 2

BROKEN SHAFT & ROD

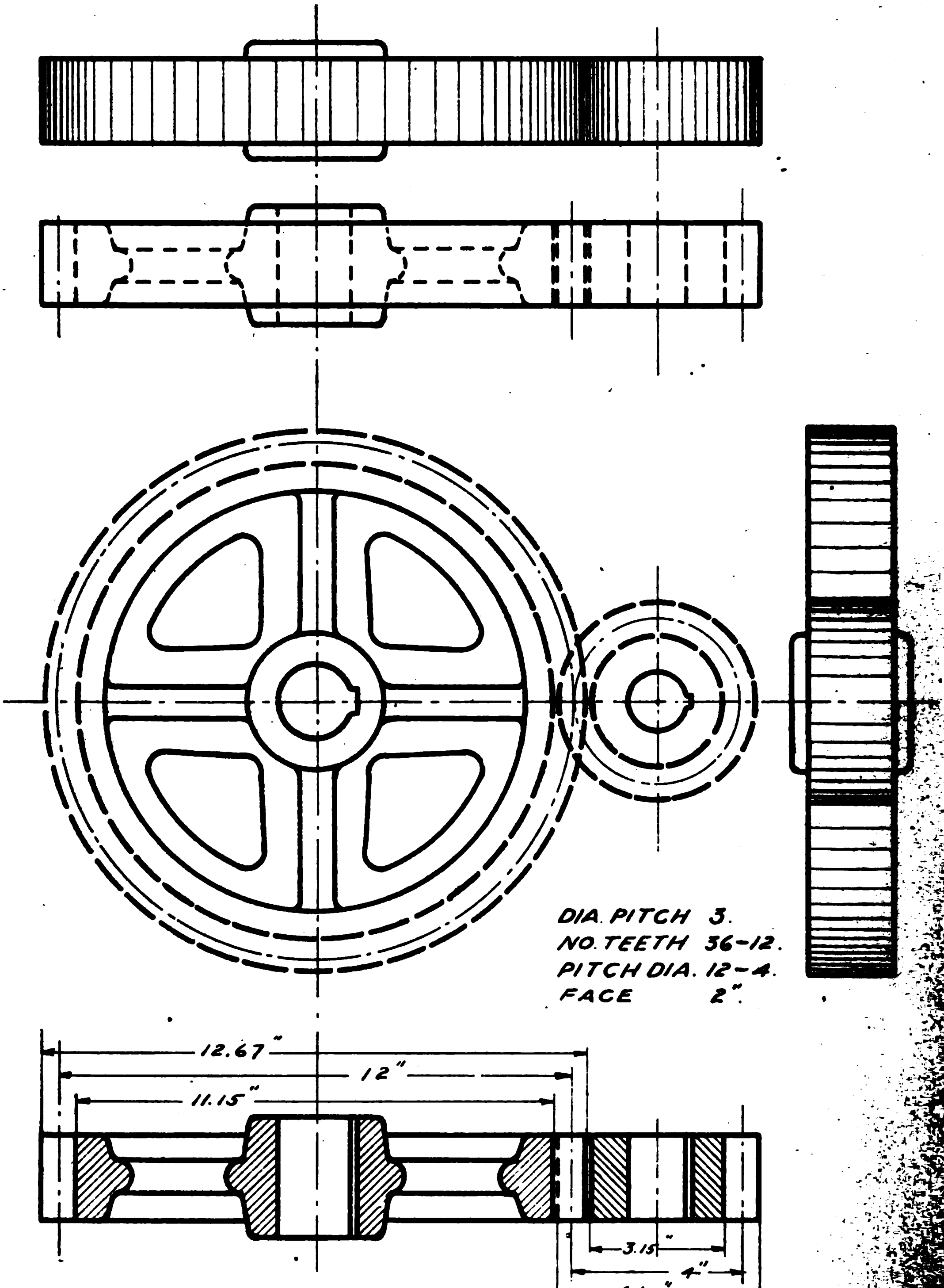
PLAT

ROUNDED CORNERS
Plate 17, fig. 1

Where rounded corners or fillets occur on a piece, show the same on the drawing. *See plate 17, fig. 1.*

BROKEN SHAFTS
Plate 17, fig. 2

Shafts and round rods when broken are to be delineated as shown on *plate 17, fig. 2.* The "break line" to be an irregular line of the shape shown.



SPUR GEARS.

PLA